Fig. 1

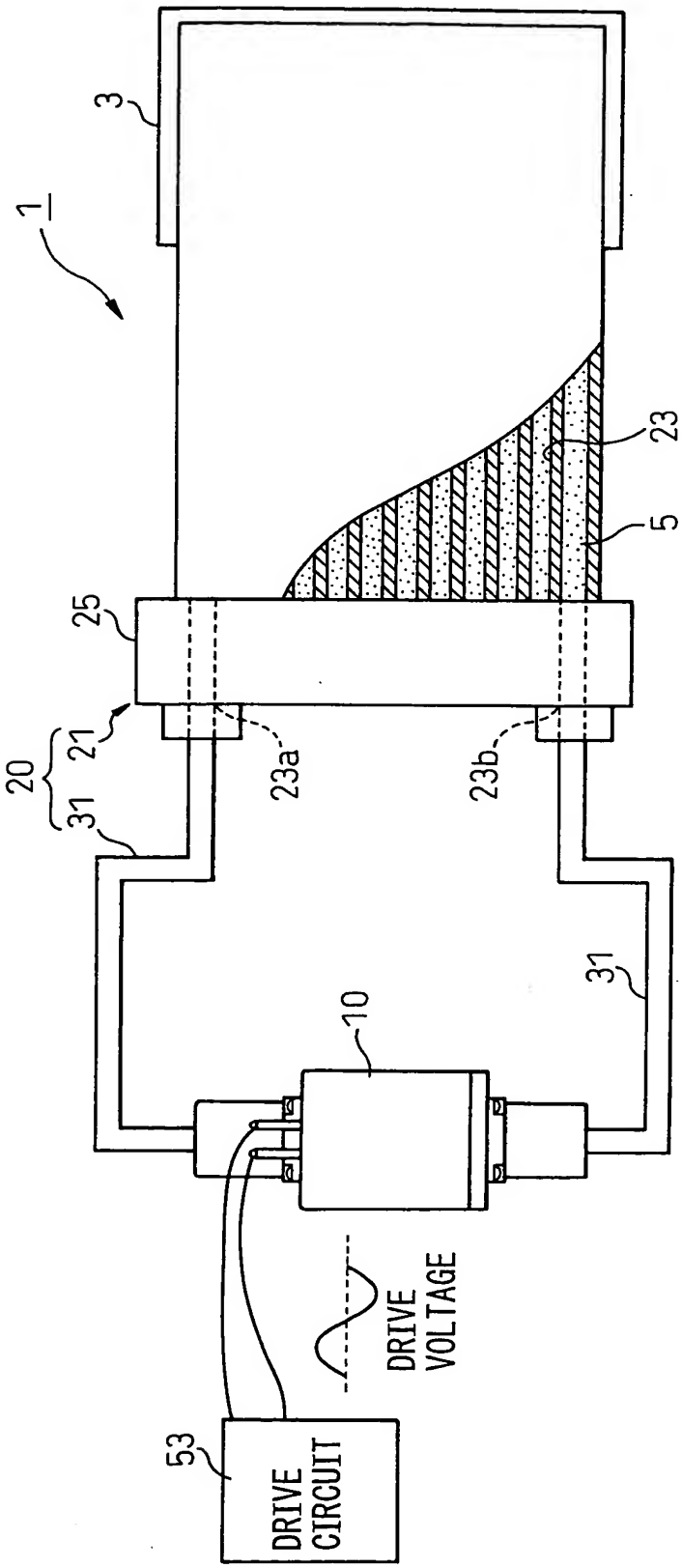
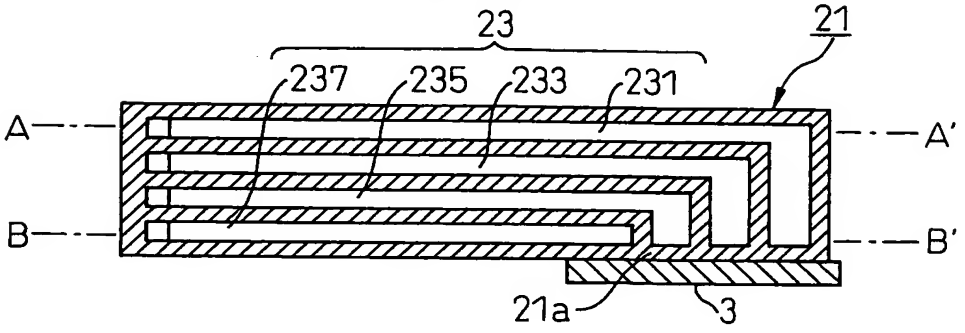
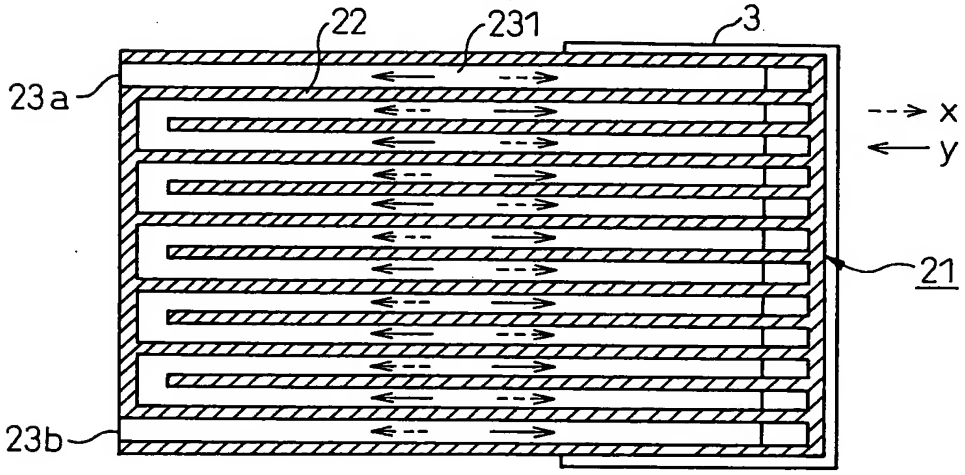


Fig. 2

(A)


23
21
237
235
233
231
A
A'
B
B'
21a
3

(B)


22
231
3
23a
x
y
21
23b

(C)

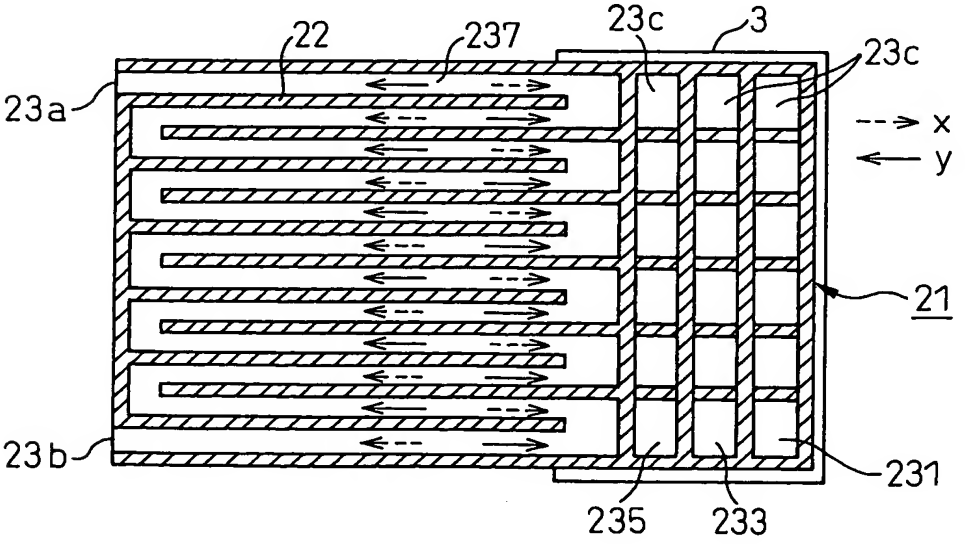

22
237
23c
3
23c
23a
x
y
21
23b
231
235
233

Fig.3

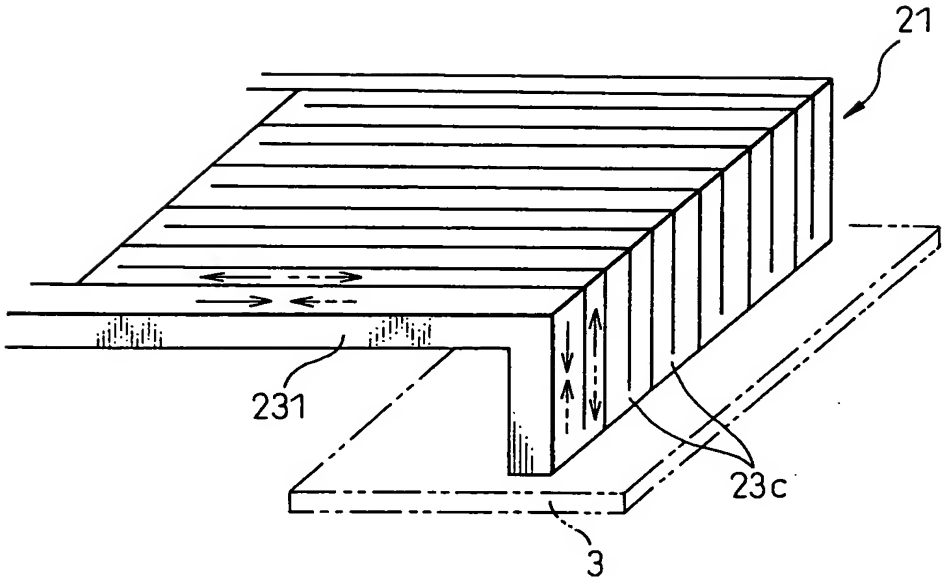


Fig.4

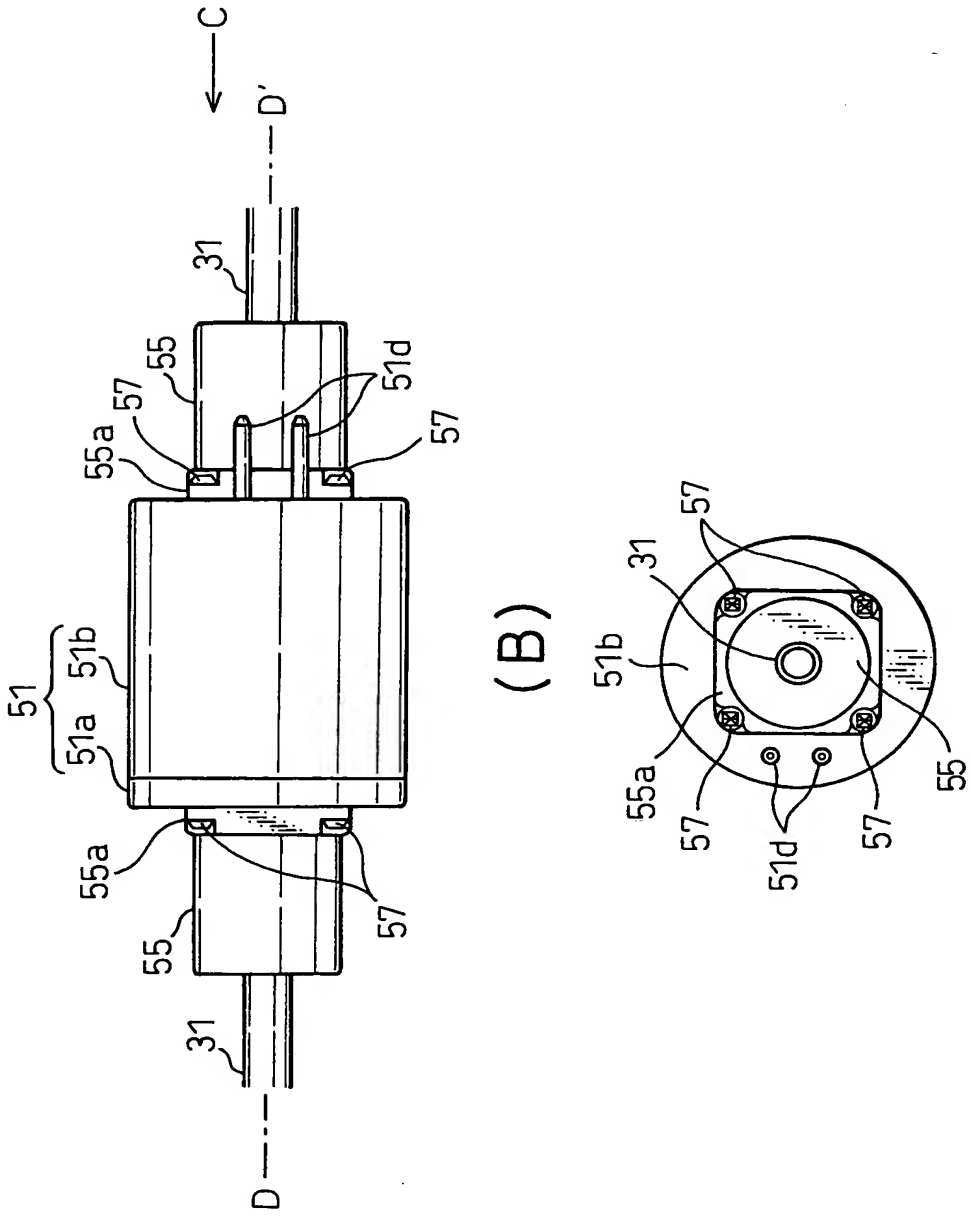

(A)
C
D'
31
55
57
51d
55a
57
51
51b
51a
55a
57
55
31
D
(B)
57
31
51b
55a
57
51d
57
55

Fig.5

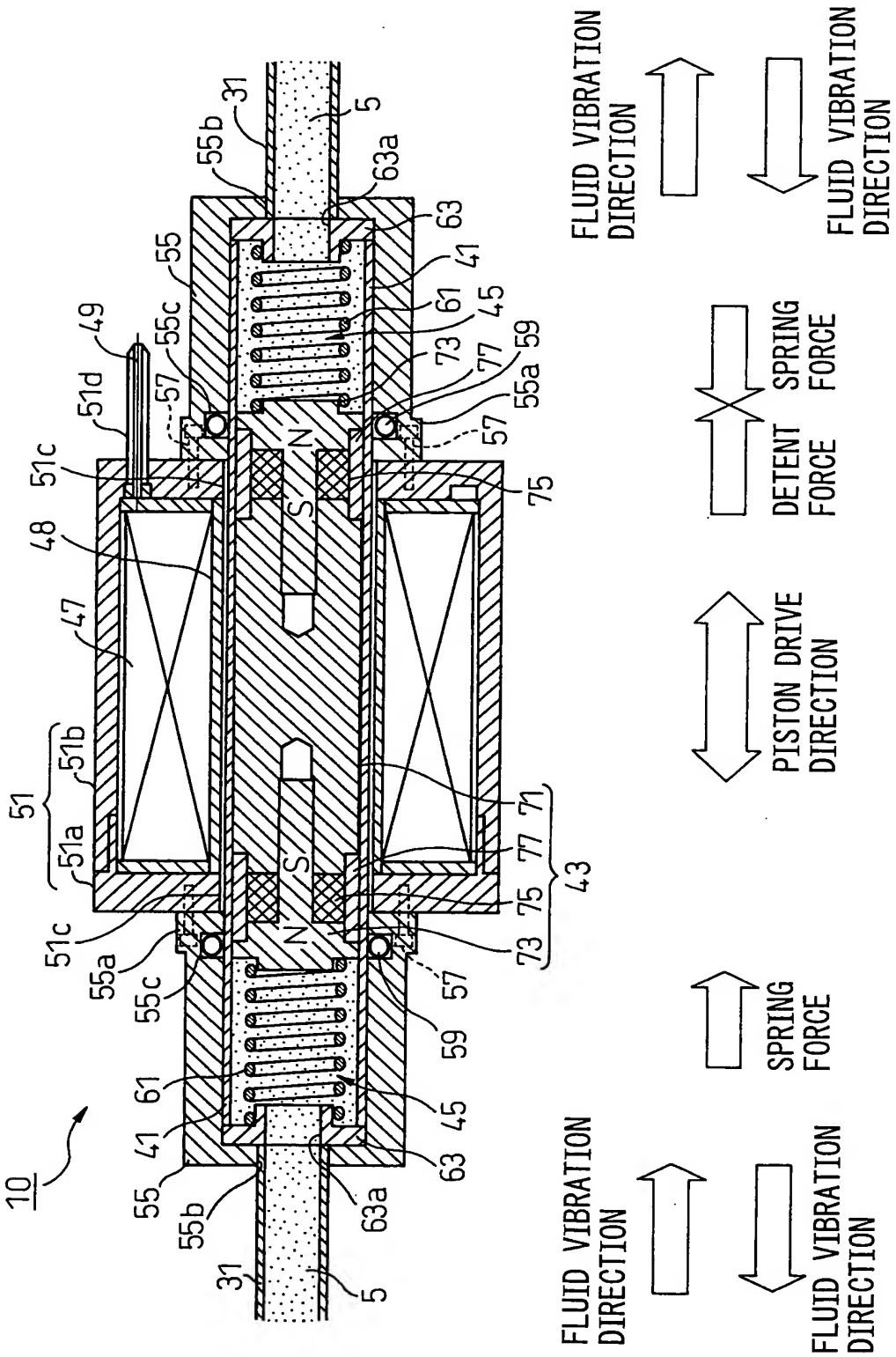

10
5
31
55b
63a
63
41
55
61
45
55c
49
73
77
59
57
55a
51d
51c
48
47
51
51b
51a
S
N
75
71
43
FLUID VIBRATION DIRECTION
DETENT SPRING FORCE
PISTON DRIVE DIRECTION
SPRING FORCE

Fig.6

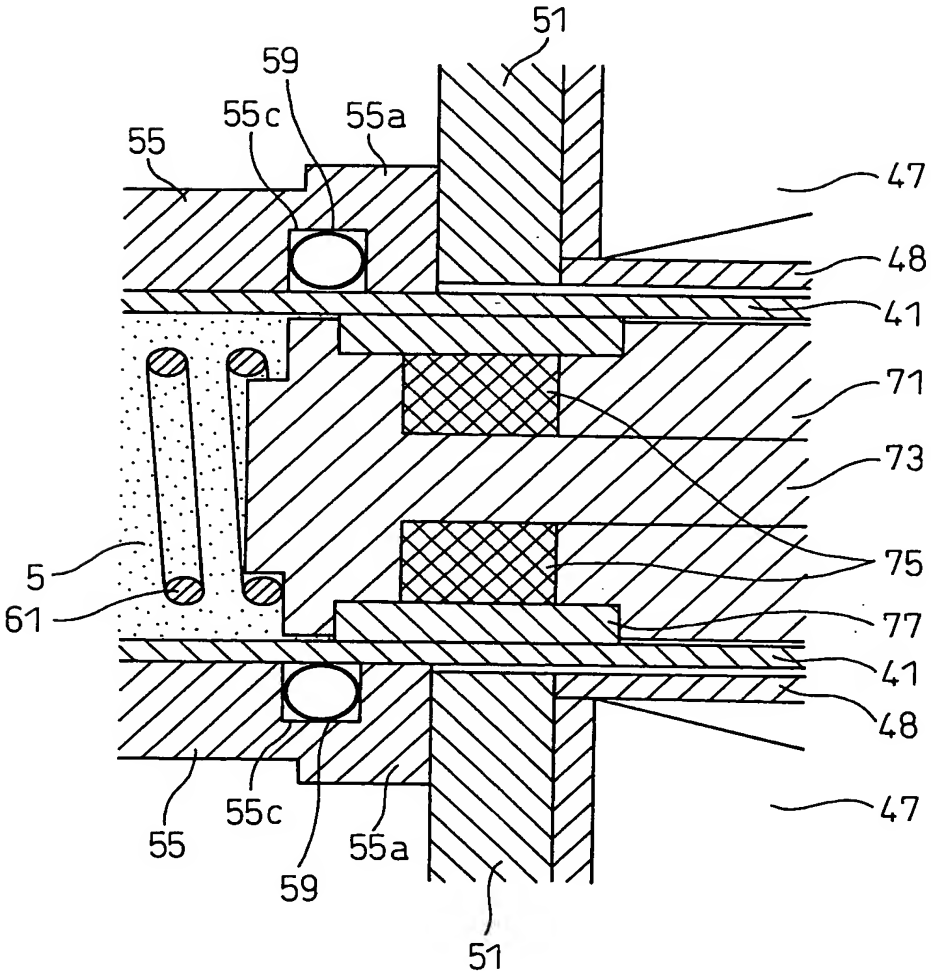


Fig. 7

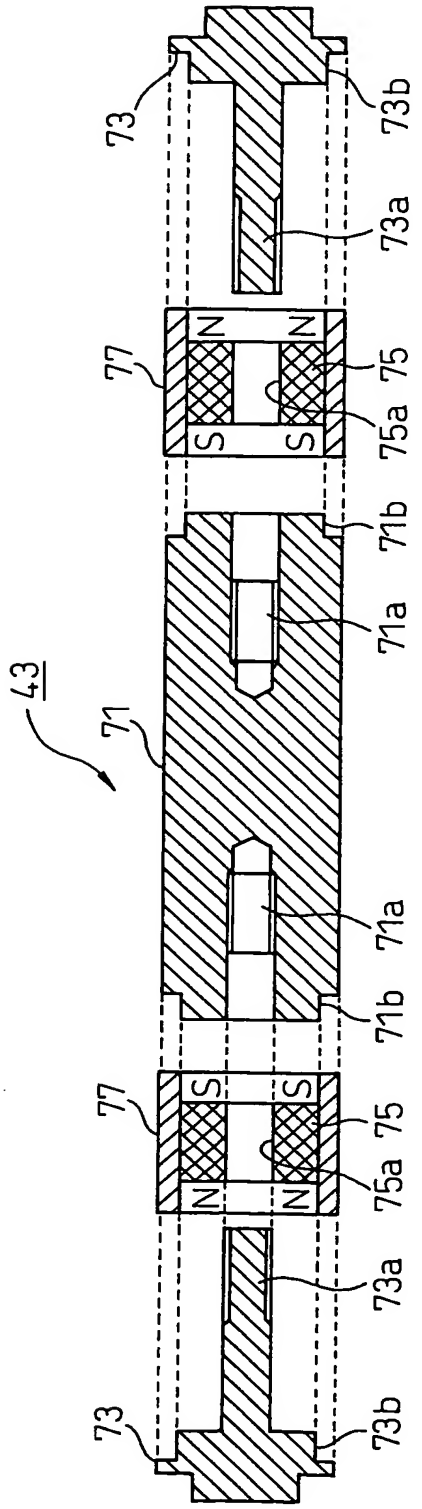


Fig. 8

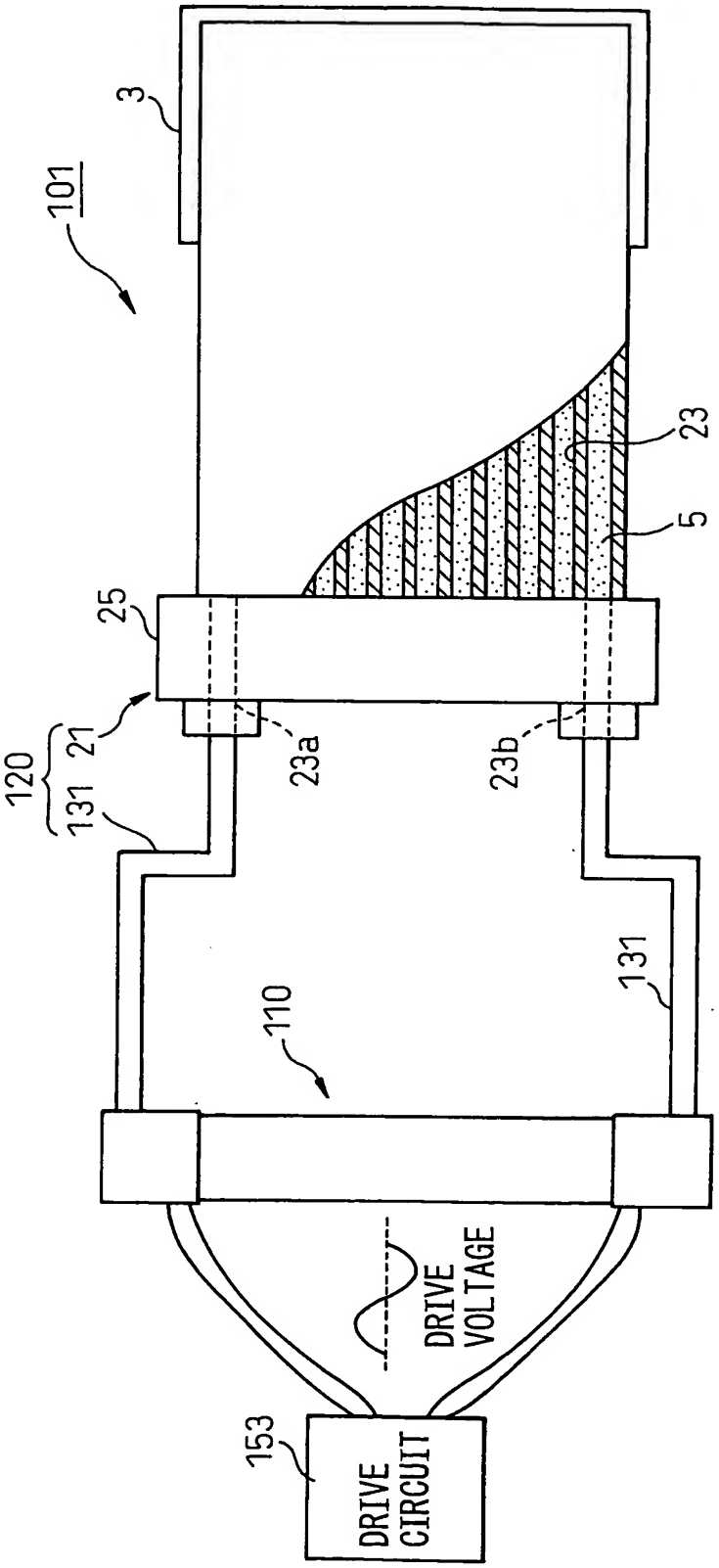

3
101
23
5
25
120
21
131
23a
23b
131
110
DRIVE VOLTAGE
153
DRIVE CIRCUIT

Fig.9

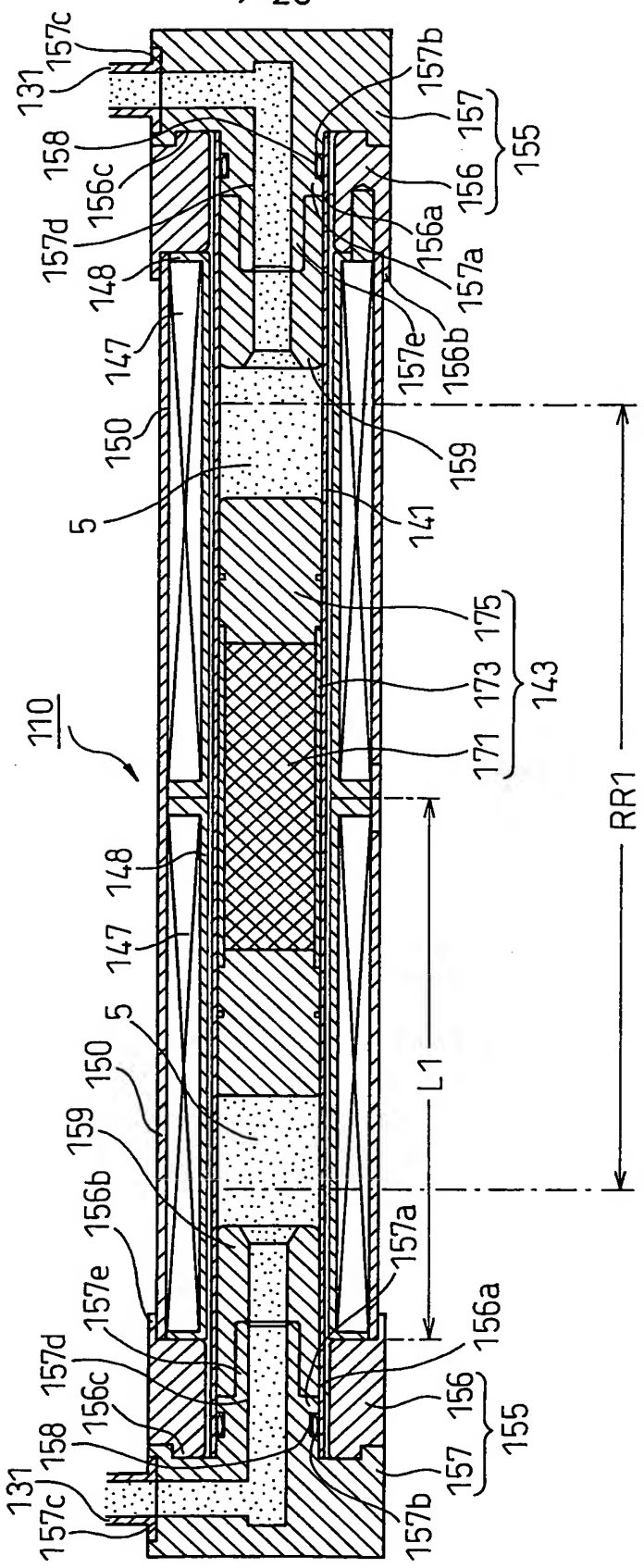

131
157c
157b
158
157
155
156c
156
157d
156a
148
157a
147
157e
156b
150
159
5
141
175
173
143
110
171
RR1
148
147
5
L1
150
159
156b
157a
157e
156a
157d
156c
156
155
158
157
131
157c
157b

Fig.10

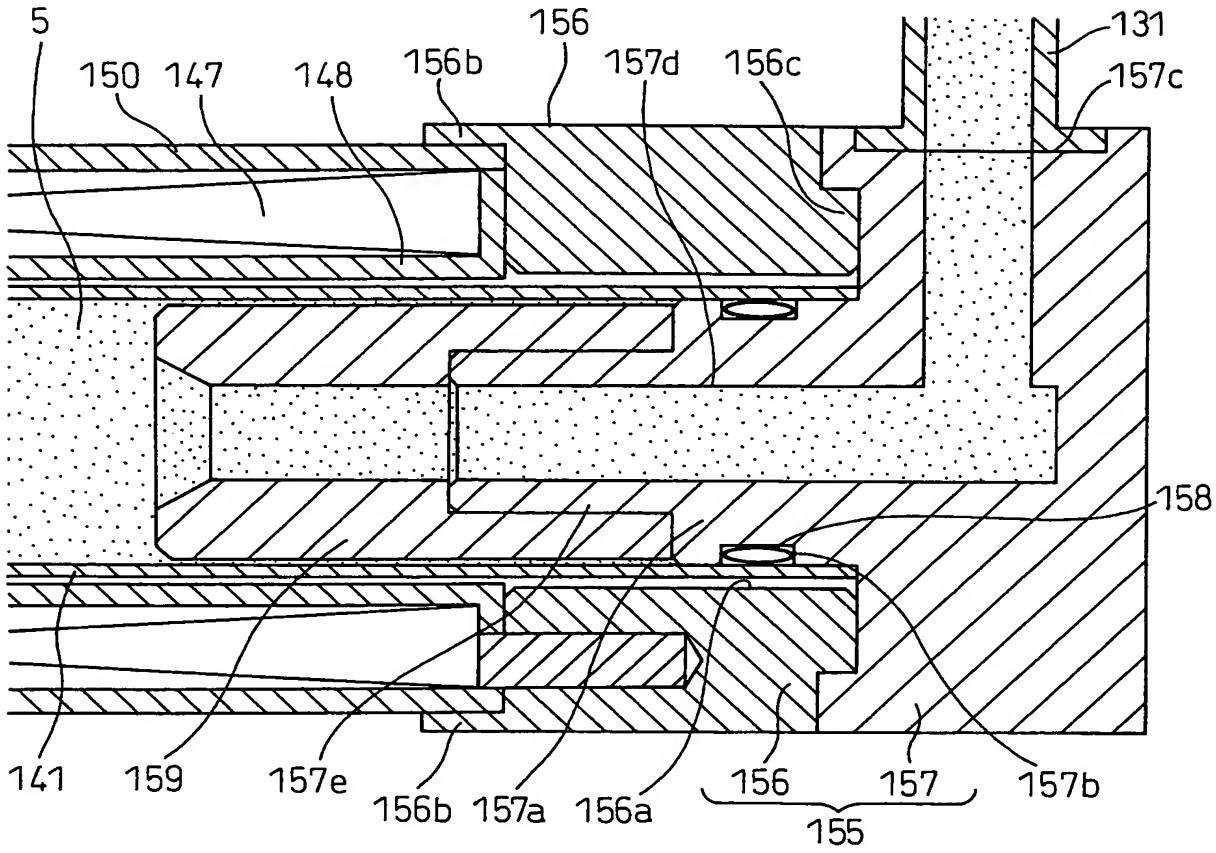

5
150
147
148
156b
156
157d
156c
131
157c
158
141
159
157e
156b
157a
156a
156
157
155
157b

Fig.11

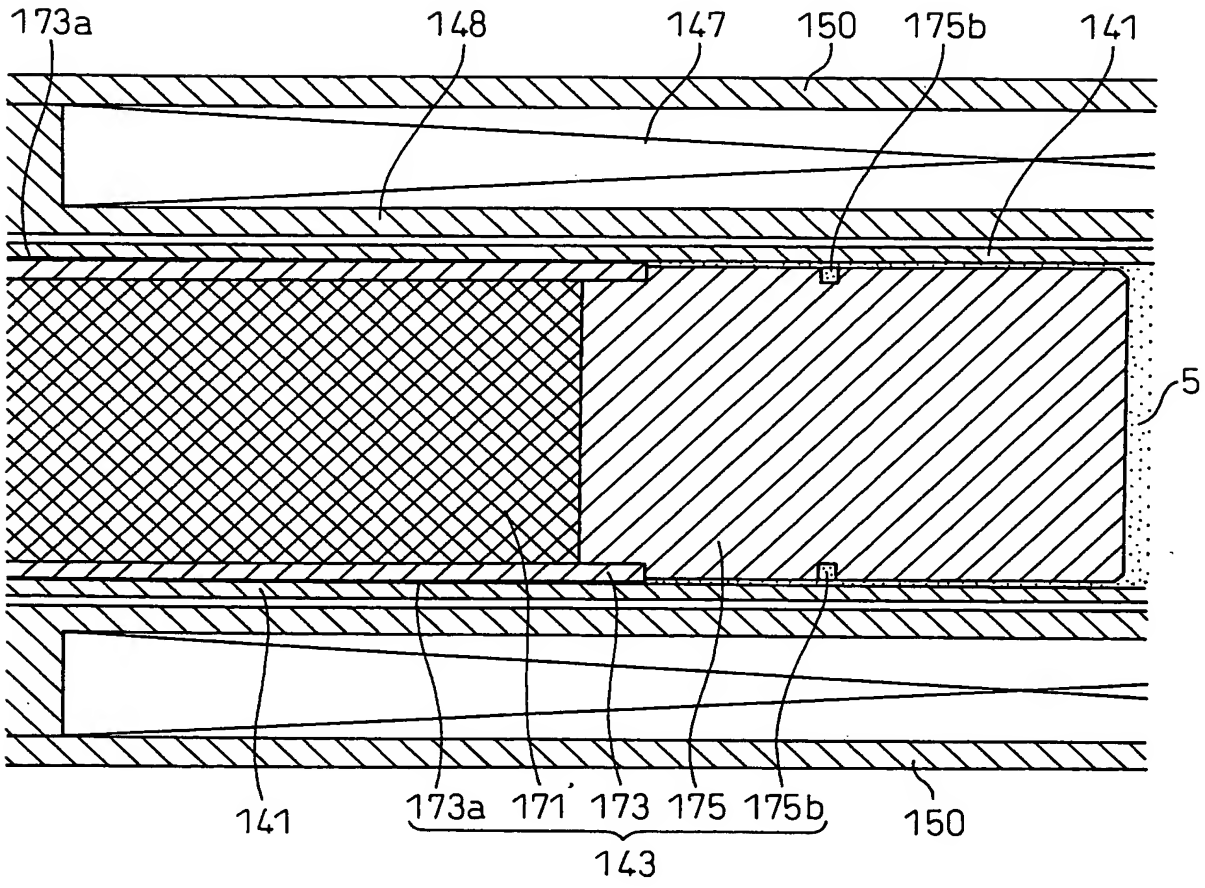
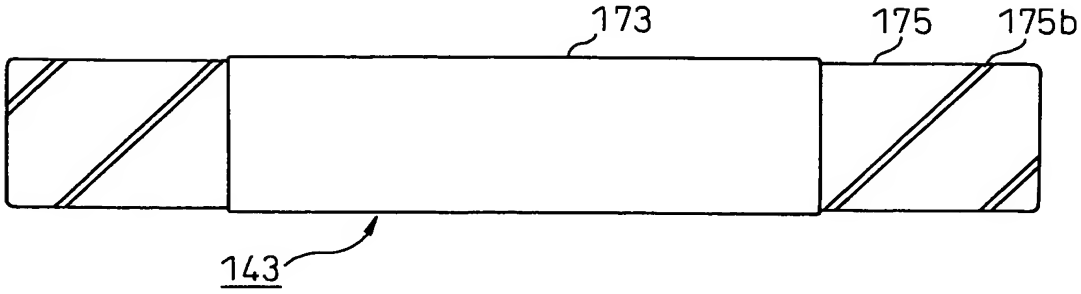
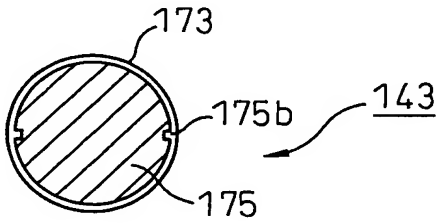


Fig.12

(A)


173
175
175b
143

(B)


173
175b
143
175

(C)

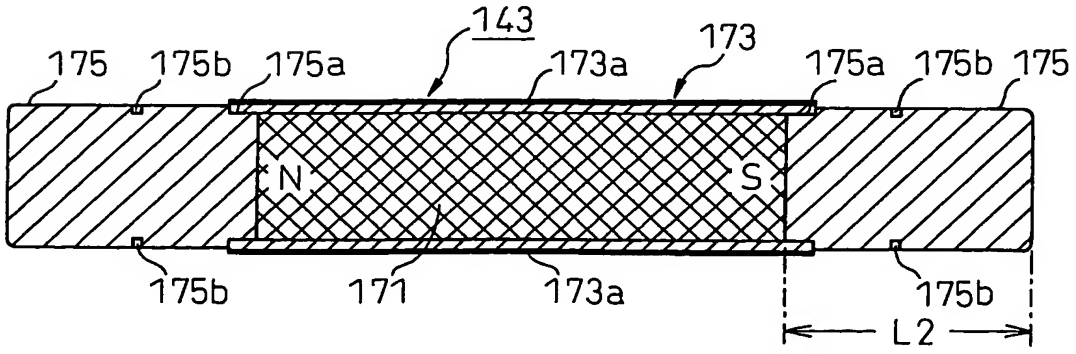

143
173
175
175b
175a
173a
175a
175b
175
N
S
175b
171
173a
175b
L2

Fig.13

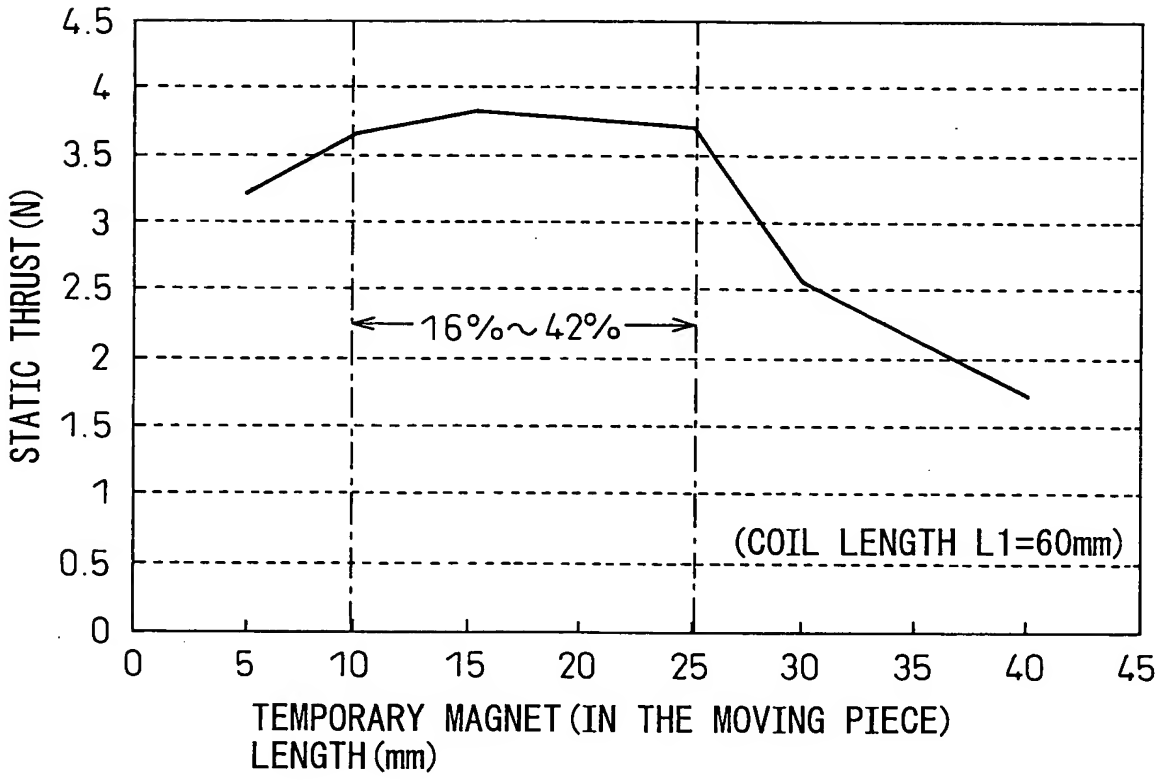
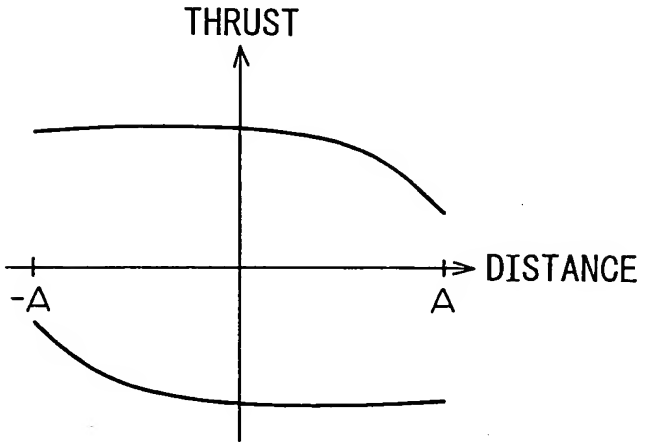
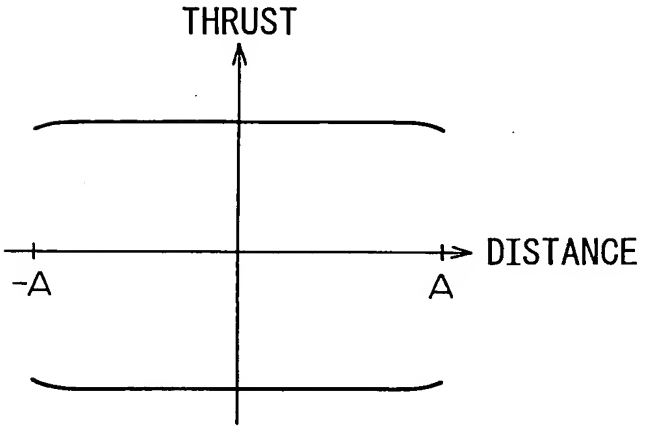

4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
STATIC THRUST (N)
16%~42%
(COIL LENGTH L1=60mm)
0
5
10
15
20
25
30
35
40
45
TEMPORARY MAGNET (IN THE MOVING PIECE) LENGTH (mm)

Fig. 14

(A)



(B)



(C)

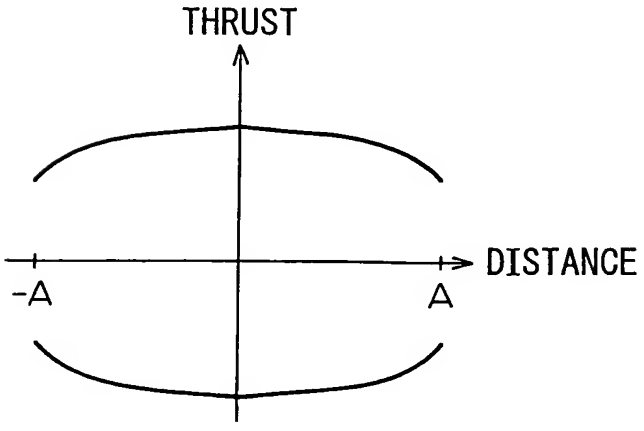
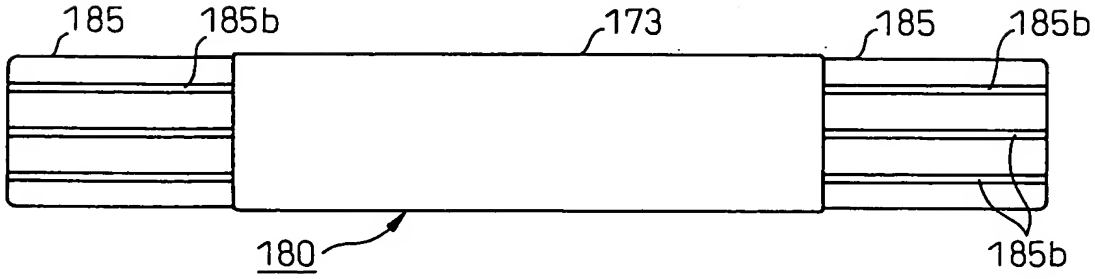
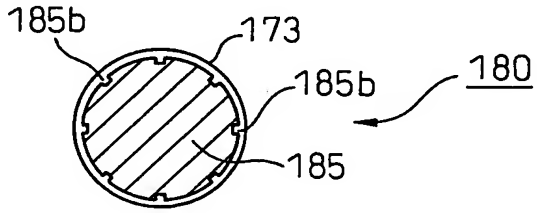


Fig.15

(A)


185
185b
173
185
185b
180
185b

(B)


185b
173
185b
180
185

(C)

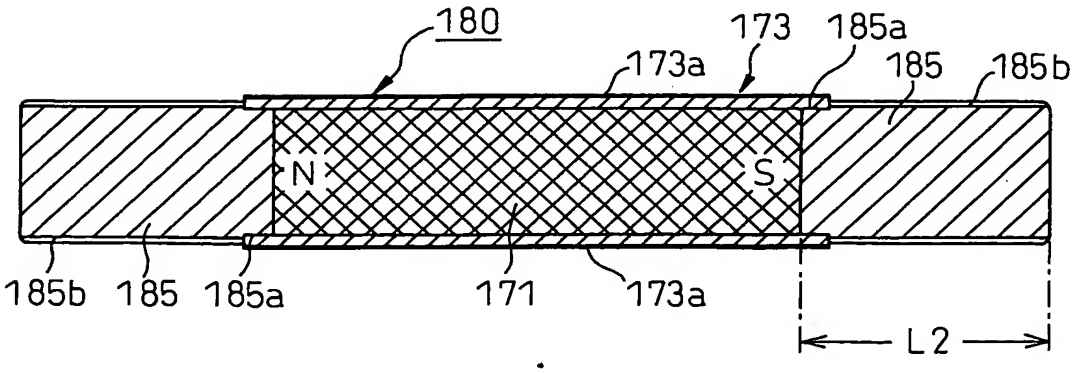
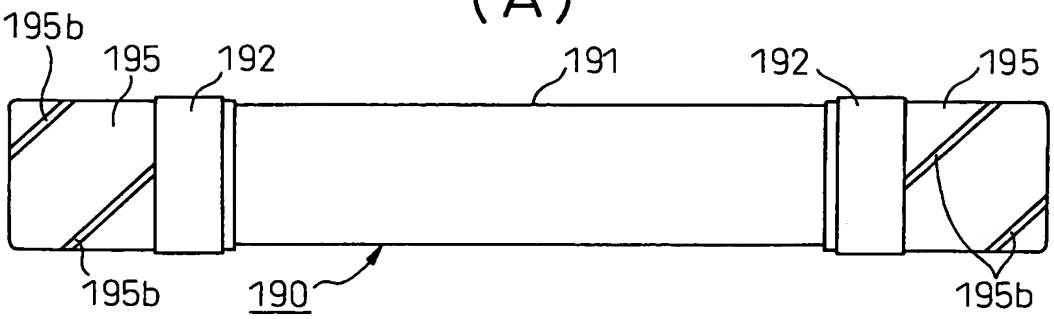
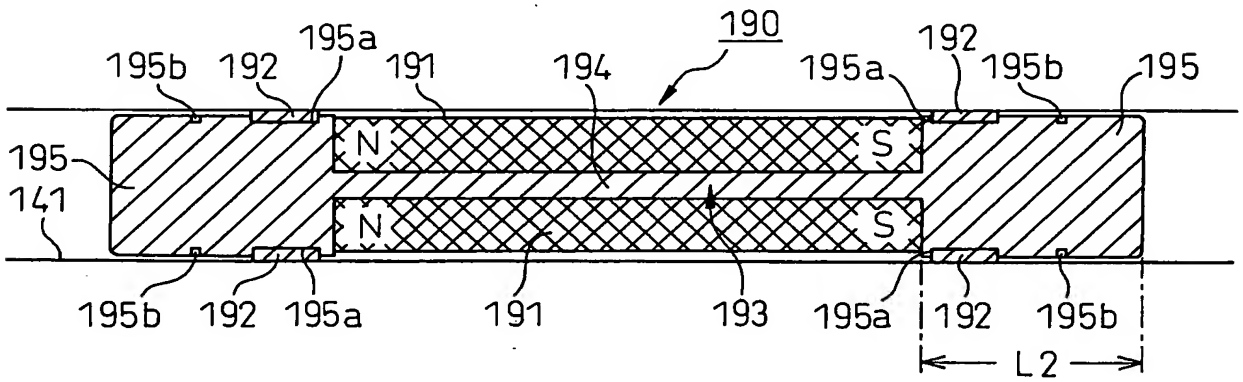

180
173
185a
173a
185
185b
N
S
185b
185
185a
171
173a
L2

Fig.16

(A)


195b
195
192
191
192
195
195b
190
195b

(B)


190
195b
192
195a
191
194
195a
192
195b
195
N
S
195
141
N
S
195b
192
195a
191
193
195a
192
195b
L2

(C)

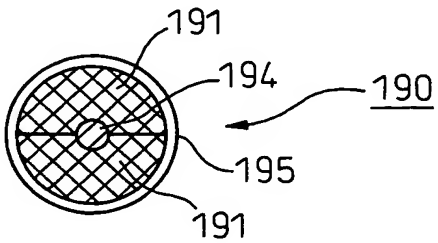
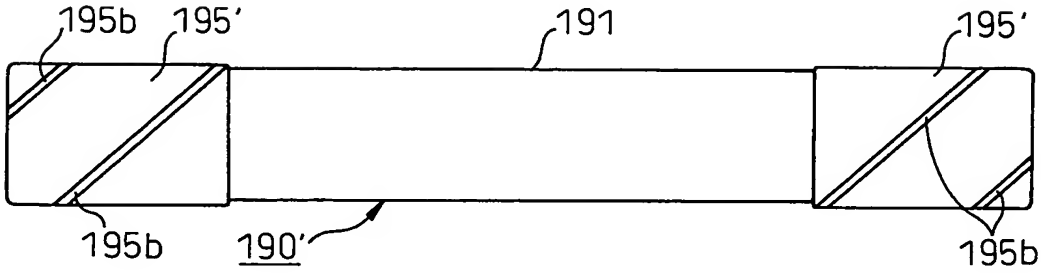
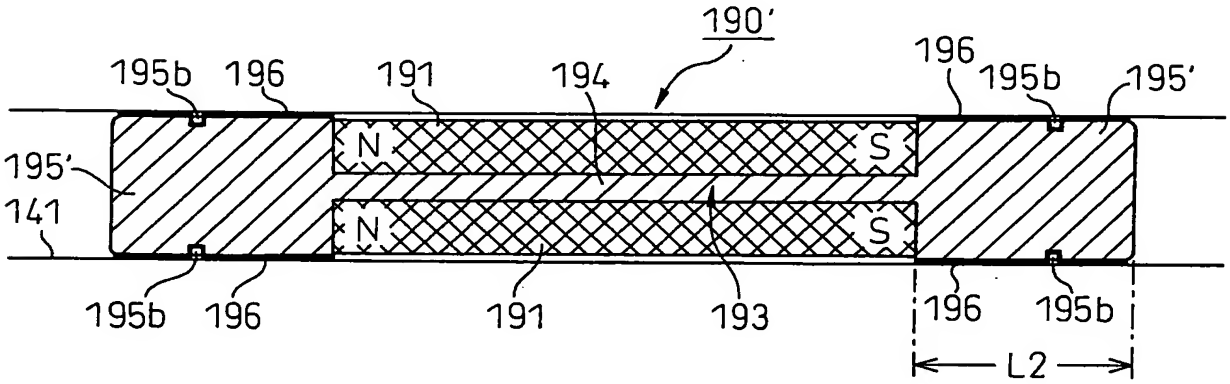

191
194
190
195
191

Fig.17

(A)


195b
195'
191
195'
195b
190'
195b

(B)


190'
195b
196
191
194
196
195b
195'
195'
141
N
S
N
S
195b
196
191
193
196
195b
L2

(C)

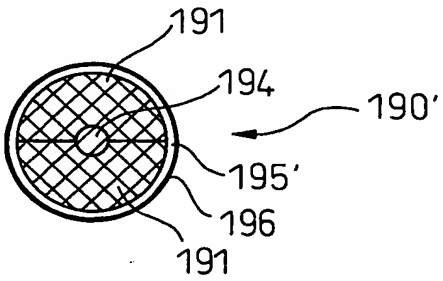
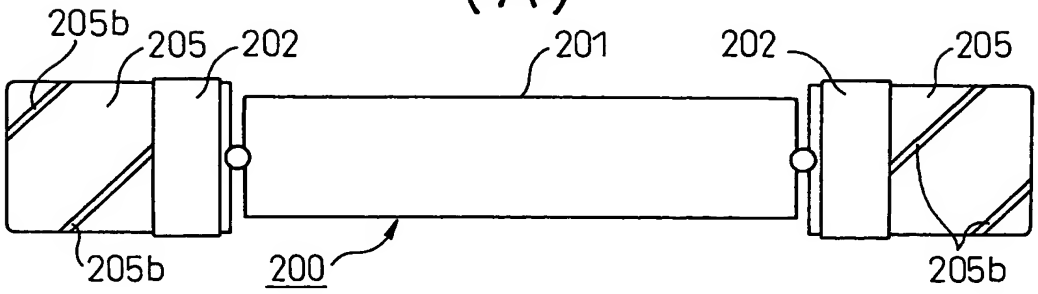

191
194
190'
195'
196
191

Fig.18

(A)



(B)

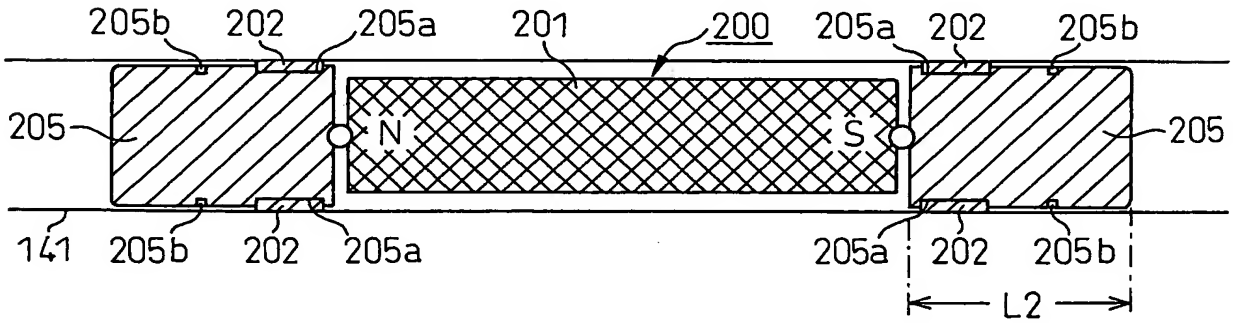
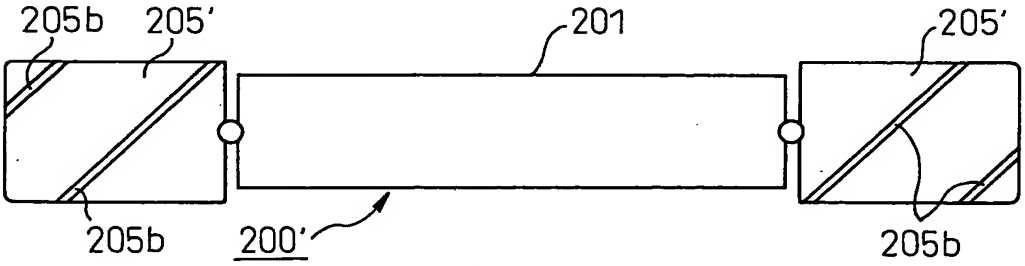


Fig.19

(A)



(B)

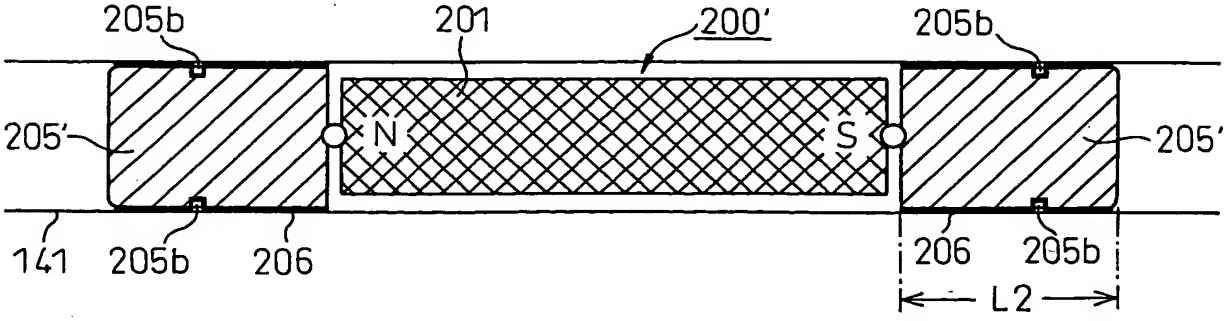


Fig.20

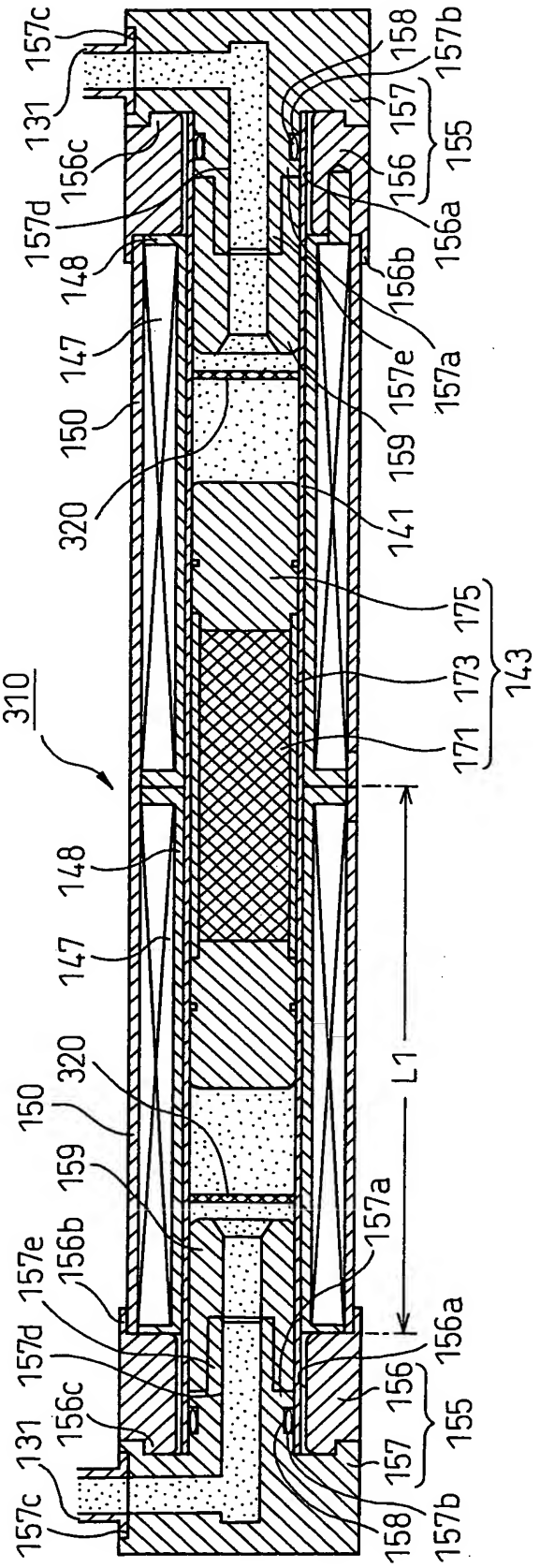

157c
131
156c
157d
148
147
150
320
310
159
157e
156b
157a
158
157b
156a
156
157
155
141
175
173
171
143
L1

Fig.21

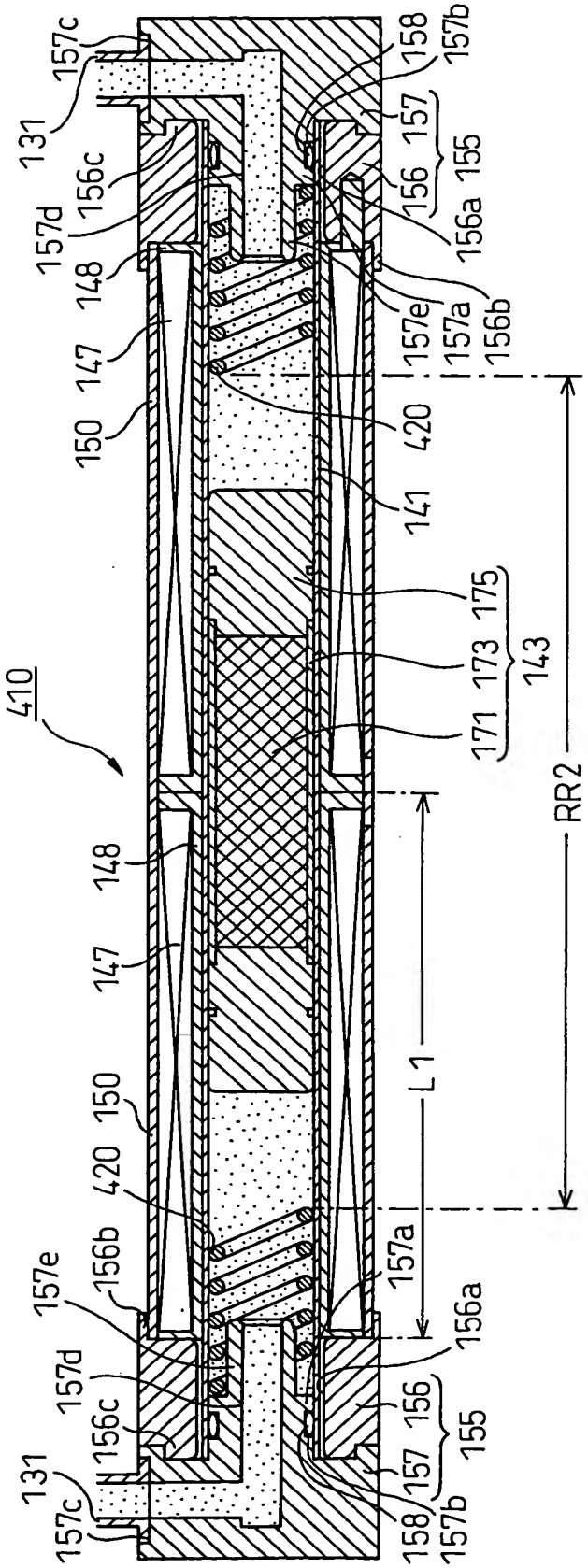

410
131
157c
157d
156c
148
147
150
420
156b
157e
157a
156a
156
157
155
158
157b
141
175
173
171
143
L1
RR2

Fig.22

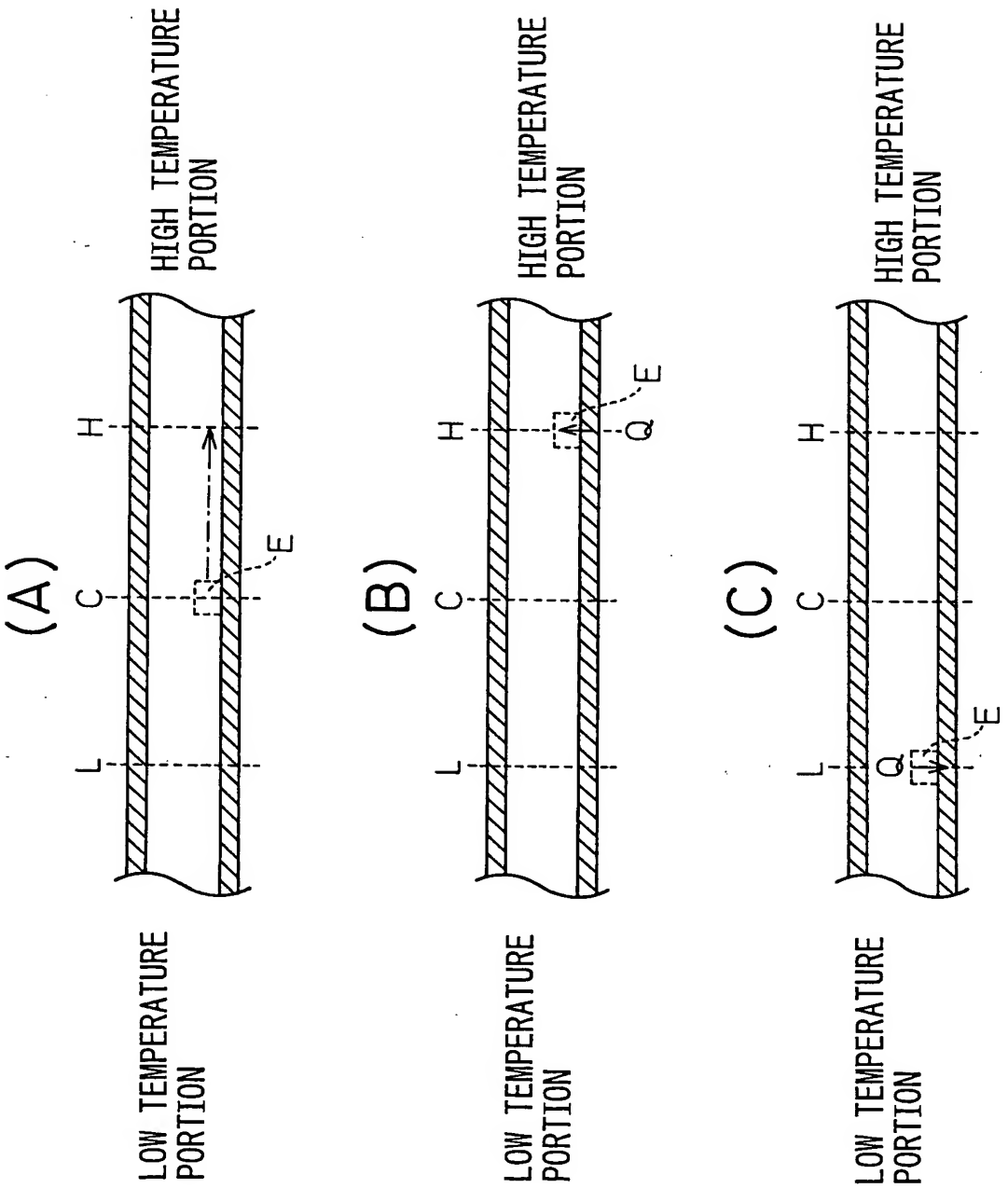
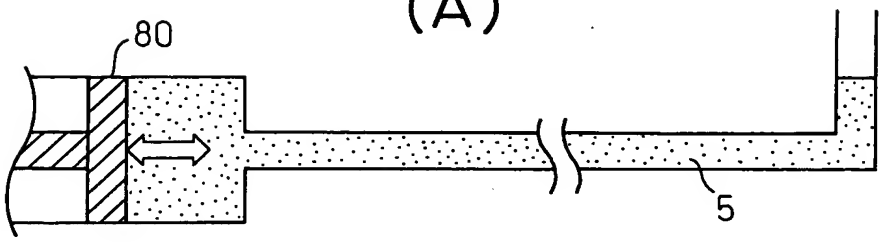

(A)
HIGH TEMPERATURE PORTION
H
C
L
E
LOW TEMPERATURE PORTION
(B)
HIGH TEMPERATURE PORTION
H
C
L
Q
E
LOW TEMPERATURE PORTION
(C)
HIGH TEMPERATURE PORTION
H
C
L
Q
E
LOW TEMPERATURE PORTION

Fig.23

(A)



(B)

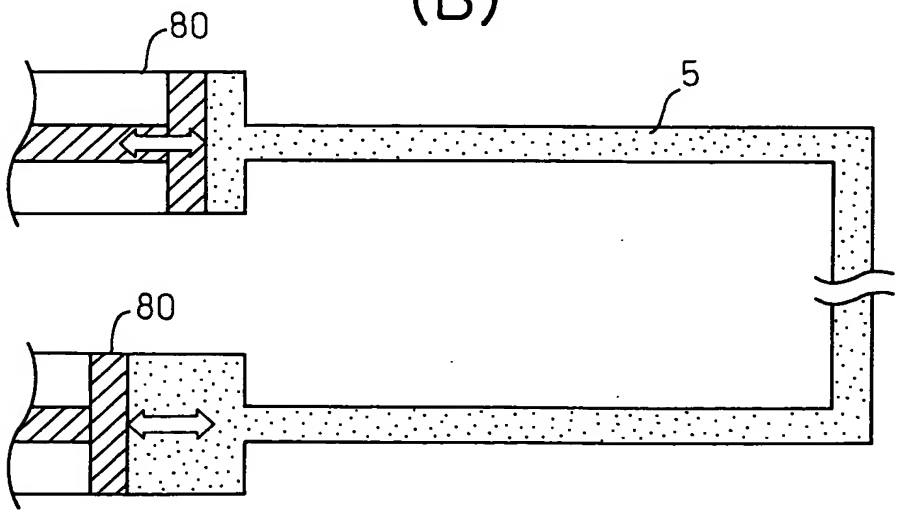
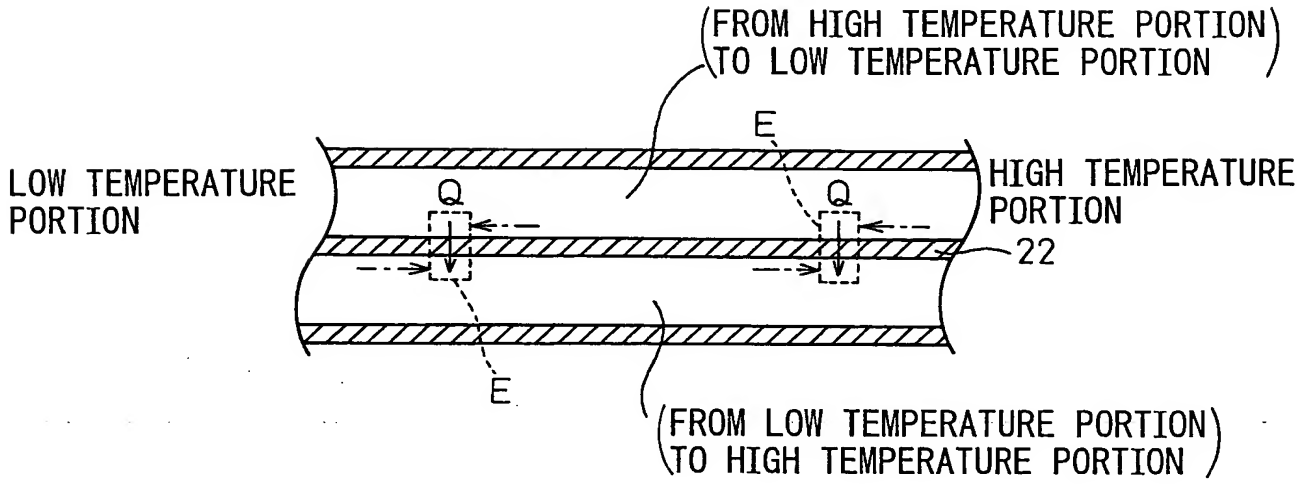


Fig.24


(FROM HIGH TEMPERATURE PORTION
TO LOW TEMPERATURE PORTION)
E
LOW TEMPERATURE PORTION
Q
Q
HIGH TEMPERATURE PORTION
22
E
(FROM LOW TEMPERATURE PORTION
TO HIGH TEMPERATURE PORTION)